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Interactive comment on "PathfinderTURB: an automatic boundary layer algorithm. Development, validation and application to study the impact on in-situ measurements at the Jungfraujoch" *by* Yann Poltera et al.

Anonymous Referee #1

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Poltera et al. present in their paper a further developed algorithm and procedure to derive boundary layer heights using ceilometer measurements. The convective boundary layer (CBL) and the continuous aerosol layer (CAL) are the two main layers which are determined. Their retrieval was tested at two sites in Switzerland and evaluated using manual (expert) examination, as well as radio sondes and applying the Richardson method. Their improved retrieval results were then used to investigate the influence of the boundary layer on continuous in-situ measurements at the high-alpine site Jungfraujoch.

The work is described in a very detailed manner. Overall, the methods applied here appear to be sound and valid. However, there is no clear separation between the method, result and discussion part, which complicates the overall reading. It appears that the structure of the manuscript has not been thought through well (e.g. a few singular subsections exist that are not followed by matching subsections) and the manuscript often reads like an extensive lab report. The resulting lengthiness of the manuscript makes it difficult for the reader to grasp the main messages. In addition, the manuscript needs a thorough editorial read (if possible by a native speaker).

The comparison to the in-situ measurements is not very convincing and needs a thorough revision. After studying the manuscript, it is not really clear to the reviewer what new findings have actually been brought up to the table. Therefore, I recommend major revisions. I encourage the authors to substantially shorten and to improve the structure of their manuscript while focusing on their main findings. More detailed comments are given below (in arbitrary order).

Detailed comments

- The current manuscript is full of acronyms. I suggest to add a table with a summary of all acronyms at the end of the manuscript.

- Page 3: Before describing the retrieval algorithm I would suggest to add a paragraph / subsection on the instruments being used.

- Page 5, line 31: Why are different bin heights used for the two different sites? Do the numbers given here relate to the vertical or to the slant path?

- Page 6, line 10: This statement ("... the overlap of the ceilometer is normally sufficiently large ...") implies that there are exceptions. Please clarify.

- Page 7, line 7-8: Why are the gradients different for the early morning periods?

- Page 7, Eq. 1 and 2: Please use a more mathematically sound way to describe your formulas (i.e. avoid entire words like 'weights' and use Greek letters instead, also add the specific time and height dependencies).

- Page 9: Second sentence is a repetition from page 6.

- Figure 1: The first and last panel show more or less the same thing and could be combined. Avoid the sub-panel titles since the date is already given in the caption. Please define the acronyms in the legend once more in the figure caption. The colour scheme in panel c is not very suitable to detect the overlaying retrieval results.

- Page 12, line 9: Here, the full overlap is stated to be at 800 m while on page 6 it is stated to be 350 m. Please clarify.

- Equation 3: It should be $S(r, t)$ to be consistent.

- Page 13: Section 4.2.1 is not followed by a section 4.2.2 as one would expect. There are also some repetitions in that section which should be removed (e.g. the information on the tilted angle). Parts of this paragraph are of motivative nature and should be moved to the introduction.

- Figure 3: Are both plots really needed here? The lower plot could be moved to the supplement and the key-numbers could be mentioned in the text. The size of the figures is quite large and could be decreased. Please improve the figure caption by avoiding individual acronyms (like 'manualPBL') and by writing full meaningful sentences so that the reader understands the figure without going to the text and finding the acronyms.

- Page 17, line 18: bR is not defined yet.

- Figure 4: Again, these two panel figures can be reduced to one main figure. The lower panel could be moved to the supplement. Please add uncertainty bars in the scatter plots. The caption is also not consistent with the axis labelling (in the figure MLH$_{bR}$ is shown which is called RS(bR 12H) in the caption).

- Page 20: Again, no section 6.1.2 is followed after 6.1.1. Have the authors really carefully thought about the structure of their manuscript?

- Sect 6.3.3, Table 1 and Figure 7: I have my doubts that these results are really robust and trustworthy. On page 22, line 2-5, the authors state that the results of the LCBLH retrieval for the winter months were not taken into account due to the lack of statistical significance. However, they are now (in terms of the LCBL and CAL reaching JFJ) discussed in detailed and presented in Table 1 and Figure 7. If the algorithm can't retrieve the height of the LCBL, how can you be sure that the JFJ is inside the specific layers? This part needs to be thoroughly revised by adding statistical values (like data coverage) to the table. The reader needs to know how trustworthy these values are. Figure 7 can be omitted since it is a repetition of Table 1 and nothing new is learned from it.

- Section 6.4: The comparison to the in-situ measurements is not very convincing. Why did the authors choose the absorption measurements (MAAP) instead of the scattering measurements (nephelometer)? Most of the signal of the ceilometer comes from particle scattering (backscattering) so I would assume it is more related to the nephelometer measurements. Figure 8 is also not convincing at all. All individual seasons show almost no correlation, while the improved annual correlation is therefore only a result of the overall seasonal variations. Besides the fact that the axis ranges in Fig. 8 are poorly chosen, I still don't understand why one would expect a linear relationship. The linear relationships are not at all clearly seen in the figures. Please clarify and revise.

- Figure 9: This figure is very difficult to interpret. The differences in the specific

seasons are impossible to distinguish. Why would one expect a linear relationship? Maybe plot the seasons separately. The y-axis range should be improved.

- The conclusion part has to be revised and shortened to the main findings. Currently it is just a repetition of the result section. What have we actually learned?

- In all figures with linear regressions: Please specify which regression type (orthogonal?) has been applied.

- For many of the figures it is not clear which averaging time or temporal resolution was used. Also an uncertainty analysis (error bars) are missing which should be added.

Minor comments

1. Abstract and beginning of section 4: CHM15k is not properly defined.

2. Page 9: Add the specific figure number before the panel label (i.e. Fig. 1a).

3. Page 2, line 31: Define 'TURB' at its first occurrence.

4. Page 1, line 25: Operating the ceilometer/lidar in a tilted mode is actually not so novel and has been performed at Kleine Scheidegg in previous work (see Zieger et al.(2012), Spatial variation of aerosol optical properties around the high-alpine site Jungfraujoch (3580 m a.s.l.), Atmos. Chem. Phys., 1, 7231-7249, doi:10.5194/acp-12-7231-2012).

5. Page 11, line 24: Remove KSE from the parenthesis.

6. Page 17, line 33: Mention the specific panel labels.

7. Page 24, line 3: Two dots

8. Page 24, line 15: I would call them pie charts and not circle charts.

9. Page 25. line 7: I would not use the word 'polluted' here.

10. Page 27, line 2: Add the missing figure number.

11. Sect. 6.4 and throughout the text: Define the height of TCAL as TCALH to be consistent with LCBLH.

12. Figure 9: The superscript in the y-axis label is not properly set.

13. All figures: Please be consistent with the format of your axis labels (i.e. obeying the case sensitivity). If you use acronyms, please define them once more in the figure caption.

Interactive comment on Atmos. Chem. Phys. Discuss., doi:10.5194/acp-2016-962, 2017.